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Pre-play communication in procurement auctions: Silence is *not* golden

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ABSTRACT

I study the effect of cheap talk between bidders on the outcome of a first-price procurement auction in which participation is costly. Although no side payments or commitments are allowed, there exists a family of equilibria in which sellers use communication to collude on a subset of participants and/or reveal information about their cost. Cheap talk matters in the sense that it strictly enlarges the set of Nash equilibria (symmetric and asymmetric) and the set of public correlated equilibria of the game. I show that the buyer may benefit from cheap talk between sellers and that the surplus increases in the amount of information revealed in equilibrium under one fairly general condition. This is because when communication is cheap, sellers cannot directly collude on higher prices. Rather, communication leads to competition between fewer, but more aggressive bidders, which entails greater allocative efficiency and a decrease in the total wasteful entry cost.

1. Introduction

Communication between bidders is one of the most important targets of competition authorities. Most of them have developed guidelines[1] to help governments improve public procurement by combating bid rigging, according to which bidders must guarantee that they did not communicate with any competitor regarding prices, the methods used to calculate prices, or the intention of whether to submit a bid. The reason for such guidelines is the conventional wisdom in industrial organization, according to which communication between bidders in public procurement would (1) discourage competition, (2) increase public spending, and (3) decrease efficiency. In this paper, I show in a first-price procurement auction with entry that none of these points is true when communication is cheap talk. First, bidders cannot use cheap-talk messages to collude on higher prices. Communication only allows for coordination on a subset of participants and/or to reveal information about individual costs. Second, communication need not lead to a higher price for the buyer. Finally, the surplus need not decrease when bidders are allowed to communicate, and actually increases in the amount of information transmitted in equilibrium.

As an illustration, consider the following (true) story. In 2010, Airbus and Boeing were competing with one another for a $40 billion aircraft contract with the United States Air Force. Because of rumors[2] that Airbus was going to bid aggressively, the European company was expected to win. In February 2011, Boeing underbid Airbus on a fixed-price contract by several hundred million dollars. Because the two rival tankers had already satisfied performance requirements, price determined the outcome. In July 2011, it was revealed that the price was so low that Boeing would take a loss on the deal: Projected development costs would exceed the contract cap by $300 million. The reasons for this fiasco are complex. Nonetheless, rumors concerning Airbus' aggressiveness apparently had no collusive effect per se, as they did not impact the number of participants, and clearly benefited the USAF, by making Boeing bid a very low price. This cast some doubts on the common idea according to which communication in procurement always harms the buyer.

I consider a buyer who seeks to obtain an object by procuring it via a sealed-bid first-price reverse auction with entry, i.e., a procurement auction. There are N potential sellers, who hold privately known costs of fulfilling the contract. Sellers have the option to pay a fixed, non-recoverable entry cost and bid a price, or to stay out of the competition. The entry cost can be interpreted either as a

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[1] See, for instance, http://competitionbureau.gc.ca/eic/site/cb-bc.nsf/eng/00599.html.

[2] Mostly spread by journalists; see, for instance, http://www.forbes.com/sites/beltway/2011/02/28/how-boeing-won-the-tanker-war/.

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direct participation cost (e.g., travel expenses, participation fees) or as a bid preparation cost (e.g., time spent on and resources allocated to preparing the bid, opportunity cost). Finally, if at least one seller participates in the auction, the contract is awarded to the seller submitting the lowest price, and payoffs are realized. Prior to making their entry decision, bidders send one round of public messages to one another. The literature[3] on collusion in auctions typically assumes the possibility of commitment and the existence of side payments. On the contrary, I assume cheap-talk communication: Messages are costless, unverifiable and non-binding.[4]

I show that even with this simple communication structure, the game admits a family of sequential equilibria, called (θ, Φ)-equilibria, in which realistic features of collusive behaviors emerge. They are constructed as follows. After the communication stage, a subset of potential bidders, i.e. a bidding ring, is selected to participate in the auction on the basis of the message exchange. Members of the ring participate if and only if their cost is below some cutoff cost, which depends on the size of the ring and on the information about individual costs revealed by the message exchange. Then actual bidders update their beliefs and play the symmetric equilibrium strategy of the procurement auction. The contract is awarded to the lowest-cost bidder, among those who participate.

Communication is thus used in equilibrium for two reasons: (1) to coordinate on a subset of participants and/or (2) to reveal information. None of these points is straightforward. First, bid rigging is difficult to enforce without side payments, because low-cost sellers have a strong incentive to deviate from the equilibrium participation strategy. Coordination obtains in (θ, Φ)-equilibria because, in the off-path event a seller outside the ring participates, bidders believe that all costs, including the deviator's, are below the equilibrium cutoff cost. This is enough to yield potential deviators a negative expected payoff and no incentive to participate. Second, because participation is endogenous, sellers have an obvious incentive to appear more competitive than they actually are. In fact, the information revealed by a seller has opposite effects on her expected payoff: "Claiming to be strong", that is, sending the same message as low-cost sellers, decreases the probability of her opponents participating but also decreases the level of their bids and thus her probability of making a winning bid. "Claiming to be weak" yields symmetric effects. Therefore, sellers use talk to trade-off bidding positions against probability of participation. In (θ, Φ)-equilibria, this trade-off results in the separation of low-cost sellers from some "out-bidders", who never participate in the auction.

Collusion thus emerge in these equilibria as the combined effect of information sharing and coordination: sellers' participation strategies only partially depend on their costs, and can be interpreted in terms of "taking turns". This closely resembles the phases of the Moon scheme used in the Electrical Conspiracy[5] in the 1950s, in which 29 suppliers of industrial electrical generators colluded in first-price sealed-bid procurement auctions. The ring used a bid rotation scheme in which each ring member was allocated a phase of the Moon, determining which of them had the right to bid at the time of the auction.

Next, I show that cheap talk matters in procurement auctions in a non-trivial way. In (θ, Φ)-equilibria, some rings may never be realized, and the participation strategies depend on the amount of information transmitted by communication. This could not occur in a Nash equilibrium of the auction game without communication, even when asymmetric, or in a public correlated equilibrium. Therefore, cheap talk strictly enlarges the set of (symmetric and asymmetric) Nash equilibria of the game (because of coordination) and does more than replicating a public randomization device (because of information revelation). Furthermore, any ex ante probability distribution on the set of bidding rings can be enforced by cheap talk in a (θ, Φ)-equilibrium.

Finally, I show that the welfare implications of cheap talk between bidders are not those expected by competition authorities. Communication decreases the number of potential bidders either directly, by selecting a ring of participants, or indirectly, by decreasing the cutoff cost. However, because of participation costs, fewer potential bidders need not decrease ex ante the revenue or the surplus. Perhaps more surprisingly, the surplus increases in the amount of information transmitted via communication under a fairly general condition regarding how bidding rings are selected in equilibrium. This is because when it is cheap talk, communication between bidders does not decrease competition: Rather, it leads to competition between fewer, but more aggressive bidders, which results in a decrease in the total wasteful preparation cost and improved allocative efficiency.

The paper is organized as follows. The related literature is described in Section 2. Section 3 presents the procurement auction with pre-play communication. Section 4 works out two examples in which pre-play communication influences sellers' equilibrium behavior. In Section 5, I define, characterize, and prove the existence of (θ, Φ)-equilibria. I also show that cheap talk matters in a non-trivial way, and that any ex ante probability distribution on the set of possible bidding rings can obtain in a (θ, Φ)-equilibrium. In Section 6, I study the welfare properties of cheap talk. Section 7 concludes and discusses the robustness of (θ, Φ)-equilibria to some assumptions of the model, and proofs are gathered in the Appendix.

2. Related literature

There is little formal theory on the role of communication in collusion. Kandori and Matsushima (1998) and Compte (1998) explore the role of communication in repeated games with imperfect monitoring, in which the fact that players observe different signals about other players' past actions makes collusion hardly sustainable. They assume the possibility for players to communicate at the end of each period and prove a Folk theorem. Aoyagi (2007) studies collusion in repeated auctions, in a model where bidders report their private signals to a center, which then returns instructions to them based on the reported signal profile.

A related model of costly pre-play communication in auctions is that of Ye (2007). He studies a two-stage auction with entry, where first-stage bids indicate firms' commitments to pay for entry. Based on the first-stage bids, the subset of the n bidders with the highest bids is selected for the second stage, and the $(n+1)$st highest rejected bid is announced to the n entrants. Indicative bids transmit information on bidders' costs. Among other results, the author shows that efficient auctions are typically characterized by a limited number of final bidders. Although Ye's model is very different from mine, it also suggests that the welfare implications of communication in auctions are more complex than they would appear at first glance.

This paper is also related to the literature on communication in competitive bidding games. Matthews and Postlewaite (1987) and Farrell and Gibbons (1987) introduce cheap talk into bargaining games, in which a single buyer and a single seller bargain over an exchange price. Although such coordination differs from that

[3] For a comprehensive survey on bid rigging in auctions, see Hendricks et al. (2015).

[4] Another way to model the effects of announcements is to suppose that they are costly. A large body of literature (beginning with Fudenberg and Tirole (1983) and Sobel and Takahashi (1983) analyzes how bargainers can improve their terms of trade by undertaking costly actions.

[5] Smith (1961), McAfee and McMillan (1992).